

**Cosmic Chemistry: Cosmogony****Cosmic Tug of War****STUDENT ACTIVITY**

In this assessment activity, you will be making a prediction about what will happen in the universe over the next 20 billion years. After reading the Student Text, “Cosmic Tug of War,” which describes three “tug of war” models, and using the references listed in the bibliography as a starting point for your research. Then you should decide which of the models you think is the most likely description of the future universe.

**THE QUESTION**

Do you think that our universe will...

- a) Continue to expand forever at much the same rate that it is now, which means it is an **open** universe.
- b) Expand until it reaches a maximum size and then collapse which would make it a **closed** universe.
- c) Expand more and more slowly until its rate of expansion is very close to zero which are the conditions for a **flat** universe?

Your answer should include at least three documented reasons for your decision.

Follow the guidelines set by your instructor for the form in which your answer to this question should be submitted.

Consider the answers to the following questions as you make your decision and complete the assignment:

1.
  - a) How much of (or what part of) the mass in the universe do **you** think that we have found?
  - b) What sources have you researched that support your answer to this question?
2.
  - a) How much more cosmic mass do **you** think there might be?
  - b) Do all scientists agree as to the presence of additional mass in the universe?
  - c) Which ones agree with your position?
  - d) How much more do these scientists think may be there?
3.
  - a) How does the amount of dark matter affect the basic precept of the standard cosmological model that our universe is isotropic and homogeneous?
  - b) How does the amount of dark matter affect our ability to determine the “average mass” (and the average density) of the universe?
4. What role will technology (telescopes and instrumentation) play in the determination of whether or not there is additional dark matter in the universe?

**OPTIONAL ASSIGNMENT**

In “The Push and Pull of the Universe” you used marbles, balloons, cotton balls, and other items in a box to model a universe filled with structures of different densities.

After you have made your decision about whether our universe is open, closed, or flat, construct a physical model of that universe, using the materials of your choice.

A written description should include:

- 1) a list of the different objects in your model and the parts of the universe they represent.
- 2) a short paragraph that explains **why** or **how** your model is consistent with your answer to THE QUESTION.